Electrochemical Deposition of Copper-Based Nanocrystalline Composite Films

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Composite films consisting of nanometer-size inert particles embedded in a copper matrix have been fabricated by electrodeposition. One purpose of this research is to obtain copper-based nanocrystalline composites with improved physical properties.

We focused on inert-particle suspensions, in which surfactants are used to disperse 50-nm particles in water to obtain stable solutions. Particle-size distribution is measured by laser light scattering (Malvern, ZETASIZER 4). Direct current (DC) and pulse current plating methods from acid solution are used to fabricate the composite copper films. Interrelated experimental factors that influence the deposition rate are particle type, additive, mass-transfer rate, current density, pH, temperature, and concentration of solutions. SEM, XRD, and AFM are used to measure the grain size, element distribution, and morphology.

Particle content in the film and current efficiency change with current density. The particle incorporation rate is also dependent on particle size. Some content of inert particles improves the physical properties of the film, for example, hardness and yield strength.

We are interested in a variety of issues relating to the electrodeposition and characterization of the nanostructures:

- Particle-size distribution in the plating bath
- Electrochemical control of nanostructure morphology
- Nanostructures as a function of particle size and concentration
- Physical properties of composite films as a function of particle concentration

We summarize our progress in probing each of these issues.